On Model Subtyping

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CONTEXT

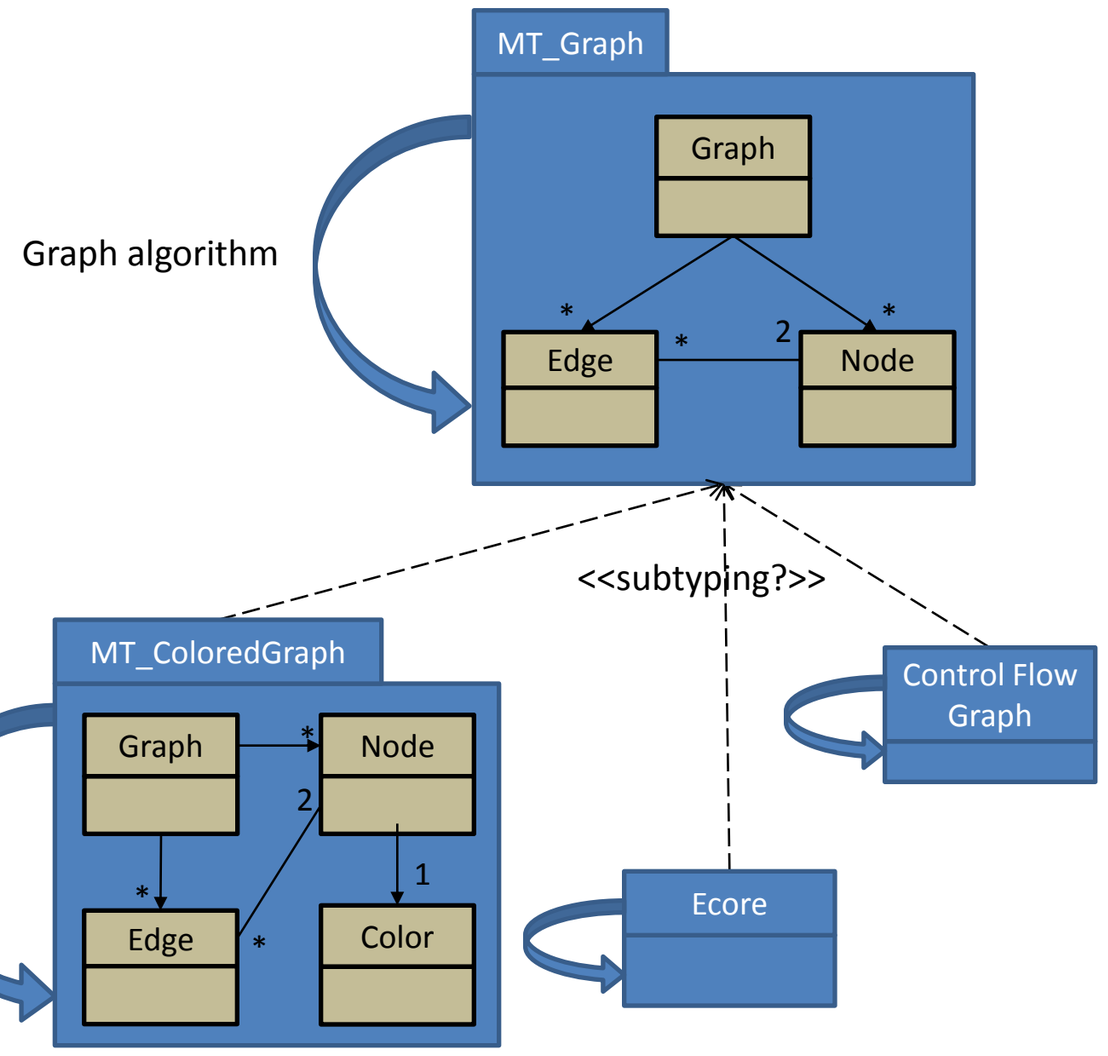
- Rapid increase of the number of modeling languages
  - More and more model manipulation operators
- Need for a systematic engineering
  - Providing design methods and **facilities** (reuse of operators and structures, advanced tools…)
- Existing approaches remain disconnected from each other

➢ Need for a unified theory

MODEL-ORIENTED TYPE SYSTEMS

- Model-oriented type systems should provide facilities such as abstraction, reuse, safety, auto-completion…

A type of a model is a set of types (MOF classes) of objects which may belong to the model, and their relations.



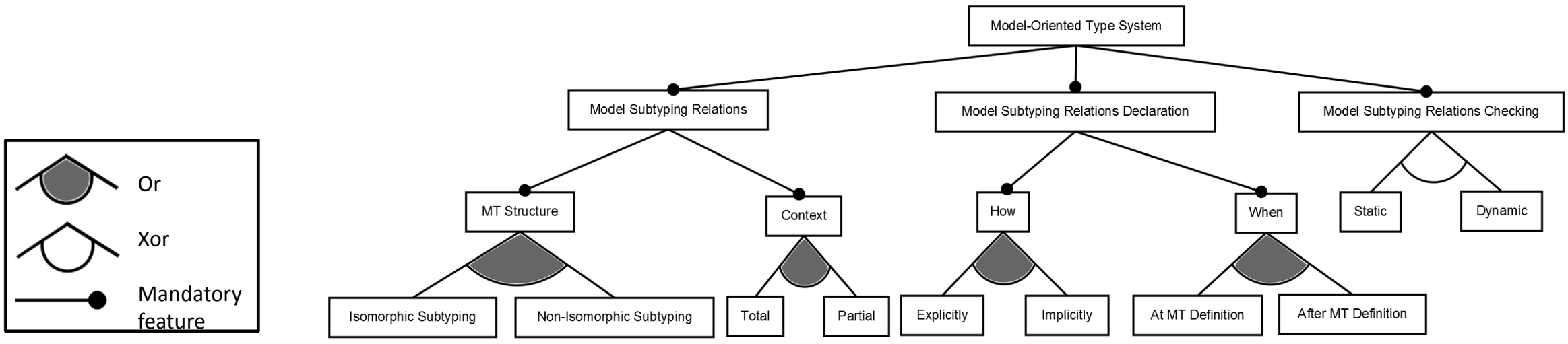
Model types for graphs

MODEL SUBTYPING RELATIONS

- How can we safely use model typed by A where a model typed by B is expected?

- Structure of the model types
  - *Isomorphic subtyping*: **Same** names, multiplicities…
  - *Non-isomorphic subtyping*: **Adaptation** from the subtype to its supertype

- Context of the subtyping relation
  - *Total subtyping*: Models typed by A can be safely used **everywhere** models typed by B are expected
  - *Partial subtyping*: Models typed by A can be safely used **in a given context** in which models typed by B are expected (e.g., a given model transformation)



A family of model-oriented type systems

	Total / Partial	Isomorphic/ ¬isomorphic	At / After definition	Explicit / Implicit	Checking	Legacy tool reuse
Varrò *et al.*	Total	Class renaming	After	Implicit	?	No
Cuccurru *et al.*	Total	Class renaming	After	Explicit	?	Yes
Steel *et al.*	Total	Class renaming multiplicities contraction	After	Implicit	At design time, with errors at runtime	Yes
Sanchez Cuadrado *et al.*	Total	Class renaming multiplicities contraction	After	Explicit	?	Yes
Sen *et al.*	Partial	Any adaptation	After	Explicit	At design time, with errors at runtime	Yes
De Lara *et al.*	Total	Class renaming navigation and filtering of properties, n-to-1 bindings	After (Binding) At (Specialization)	Explicit	?	No
Babau *et al.*	Total	Isomorphic	After	Explicit	?	Yes

Classification of existing approaches for model manipulation reuse

CLASSIFICATION OF EXISTING APPROACHES

- Underused approaches:
  - Partial subtyping (i.e., subtyping wrt. a specific context)
  - Implicit declaration of a subtyping relation
  - Declaration at the definition of a type
  - Isomorphic subtyping (too restrictive)
- Lack of information on subtyping relations checking

PERSPECTIVES

- Could we propose a type system providing each one of those features?

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